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Specification and Drawings, as originally filed, with Application for Patent Serial No:
2,428,677, on May 15, 2003, by ANATOLIY FISENKO, for "A Method of Induced
Froth (Foam) Formation Process and Natural Purification."

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ABSTRACT

A method of induced froth (foam) formation and natural purification from pollutants or contaminants for water treatment, wastewater treatment, clean-up of polluted sites of streams directly on site, clean-up of contaminated sites and any other reasons is proposed. The method utilizes the proper selected food for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms which are the most resistant to the kinds of contaminants or pollutants from which water, wastewater and polluted or contaminated sites are treated or cleaned-up. While the decomposition takes place, the entire water and/or benthic soil are enriched with biological surfactants and the generated dissolved biogases and micro-bubbles of biogases. Further, the water, wastewater and polluted or contaminated sites also contain the dissolved air and all kinds of polluting particles, including man-made surfactants. By creating the proper external and/or internal conditions for forming biogases and/or air micro-bubbles and bubbles-particles aggregates in the presence of biological and/or man-made surfactants, the latter rise to the water surface and concentrate in froth and a surrounding thin top layer of surface water. The froth and surrounding thin top layer of surface water collect the contaminants or pollutants, including organic and inorganic particles with pathogens from the entire water and/or benthic soil. The froth and surrounding thin top layer of surface water are concentrated and localized in the proper designed places by any devices or equipments for further skimming off for disposal and/or redirecting to artificially created places for natural treatment directly on site and/or delivering to municipal or natural treatment facilities.

A METHOD of INDUCED FROTH (FOAM) FORMATION PROCESS and NATURAL PURIFICATION

The present invention relates to the water treatment, wastewater treatment, clean-up of polluted sites of streams directly on site, clean-up of contaminated sites and any other reasons from pollutants or contaminants.

In the patent, U.S. Pat. No. 4,244,819, dated Jun., 1981, a floating anti-pollution barrier for combating water pollution is disclosed. The floating pockets of the barrier, the openings of which are downwardly disposed, are given their shape and kept in shape by masses of a material which is lighter than water.

10 In the patent, U.S. Pat. No. 5,122,165, dated Jun., 1992, a process system and apparatus for removal of toxic volatile compounds and surfactants from a contaminated liquid stream is described. This process system involves liquid pumping; gas purification by a foam collector; etc.

Flotational separation techniques, especially the techniques such as those in U.S. Pat. No. 5,306,422 dated Apr., 1994 and U.S. Pat. No. 5,538,631 dated Jul., 1996 allow to treat the waste water.

In the patent U.S. Pat. No. 5,840,156 dated Nov., 1998, a froth flotational process for deinking wastewater using multiflow pressurized deinking module is disclosed.

20 To the best knowledge of Your Petitioner the proposed induced froth (form) formation process and natural purification method is based on discovered natural phenomenon – natural froth formation process by which the river purifies itself in extraordinary circumstances (after a toxic spill), not only entire water but also the affected benthic soil, to the environmentally acceptable levels for these particular habitats. Nature showed us the manner in which a river purifies itself. With the knowledge of the natural purification of creeks and rivers through froth formation, our next step was to understand the mechanisms involved in this process. In brief, our hypothesis is the following:

30 In the decomposing process of total organics, including organic pollution, the river, including the entire water and the benthic soil, are enriched with natural biological surfactants such as humic acids, amino acids, fatty acids and others; and the generating dissolved biogases and micro-bubbles of biogases such as oxygen, ammonia, carbon dioxide, nitrogen, methane, hydrogen sulfide and others. This system also contains dissolved air, air bubbles created from the air captured from atmosphere and all kinds of polluting particles, including man-made surfactants.

For generating air and/or biogases micro-bubbles and attaching of the polluting particles to the air and biogases micro-bubbles in the presence of the biological and man-made surfactants and further for rising the bubbles-particles aggregates as well as the decomposed matter from the benthic soil to water surface, the proper external and/or

40 internal conditions must exist. Water cascading over the weirs, waterfalls and other obstacles, creating the shallow-turbulent character of the stream current is the one of examples of the suitable condition for bubble-particle attachments. The particles-bubbles aggregates as well as the decomposed matter which are enriched with micro-bubbles of biogases will rise to the water surface of the river downstream from the weirs, waterfalls and other obstacles, creating the shallow-turbulent character of water current and concentrate in the froth and the surrounding thin top layer of surface water. The resulting froth and the surrounding thin top layer of surface water comprise a high concentration of polluting agents from both the entire water and the benthic soil. This process affects all the pollutants, organic and inorganic, including pathogens.

50 The formed froth and the surrounding thin top layer of surface water are concentrated and localized in the proper designed places by any devices for further skimming off for disposal and/or redirecting to artificially created places for natural treatment directly on site and/or delivering to municipal or natural treatment facilities.

As a result, we can, without any chemical addition, by utilizing the natural purification processes only, intervene directly on site in water treatment, wastewater treatment, clean-up of contaminated sites or clean-up of the streams that is heavily polluted from both the point and the non-point polluting sources or any other reasons.

60 In fact, what do you immediately notice when you visit Niagara Falls? Of course, you are first struck by the majesty of the view. You are impressed by the power and volume of water. Look more closely. You will also see a great deal of froth on the water surface. The froth gathers along the banks in large amount.

Did you consider the question, why does the froth accumulate? One normally does not give much thought to this point. In fact, this is the manner in which the river purifies itself from all kinds of pollutants, including pathogens.

In drawings which illustrate an example of the embodiments of the invention, Figure 1 is a top view that presents a schematic view of the process for removing the froth and thin top layer of surface water from polluted sites of stream directly on sites, where:

- 1 is a weir in stream;
- 2 is a shallow-turbulent area of water current in stream;
- 3 is a direction of surface water flow;
- 4 is surface water;
- 5 is a direction of froth and thin top layer of surface water flow;
- 6 is a device or equipment for stopping, concentrating, localizing and/or redirecting of froth and thin top layer of surface water in the proper places for removal;
- 7 is a skimmer with pipe for pumping the froth and thin top layer of surface water from the proper places to a tank;
- 8 is the tank;
- 9 is a bank of stream.

In drawings which illustrate an example of the embodiments of the invention, Figure 2 is a top view that presents a schematic view of the process for natural biological treatment of froth and thin top layer of surface water directly on polluted sites of stream, where:

- 1 is a weir in stream;
- 2 is a shallow-turbulent area of water current in stream;
- 3 is a direction of surface water flow;
- 4 is surface water;
- 5 is a direction of froth and thin top layer of surface water flow;
- 6 is a device or equipment for stopping, concentrating, localizing and/or redirecting of froth and thin top layer of surface water in the proper places for biological treatment;
- 7 is a bank of stream;
- 8 are rushes or any other plants using for artificially created biological treatment in the proper places where the froth and thin top layer are concentrated and localized.

In drawings which illustrate an example of the embodiments of the invention, Figure 3 is a top view that presents a schematic view of the equipment or device using for stopping the tree logs or other heavy debris in stream for further removal them, where:

- 1 is a direction of surface water flow;
- 2 is a bank of stream;
- 3 is surface water;
- 4 is a metallic stick;
- 5 is a tree log;
- 6 is a metallic rope.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of induced froth (foam) formation process and natural purification from pollutants or contaminants for water treatment, wastewater treatment, clean-up of polluted sites of streams directly on site, clean-up of contaminated sites and for any other reasons;

the said streams hereinafter mean: rivers, creeks and any other streams;

the said polluted sites of streams or contaminated sites hereinafter mean:

a) the streams sites polluted from point and/or non-point polluting sources, for example, but not limited by these examples, the said streams sites polluted from the different kinds of runoffs, including urban, agricultural, stored animal farms, sewage, domestic, textile and paper manufactures, mining operations and any others polluted streams sites;

b) the site with contaminants, for example, but not limited by this example, the said site contaminated with arsenic at mine sites or any other contaminated sites;

c) the stream sites polluted after toxic, chemical and any spills.

the said polluted sites of streams or contaminated sites include:

a) the polluted or contaminated water, wherein the said polluted or contaminated water includes running water or water at rest, wherein the said polluted or contaminated water is not within the acceptable limits for water quality standards,

or

b) the polluted or contaminated benthic soil, for example, but not limited by this example, the said benthic soil polluted with cyanide and heavy metals after toxic spills,

or both

c) the said polluted or contaminated water and the said polluted or contaminated benthic soil, for example, but not limited by this example, the said benthic soil and the said water polluted after chemical spills.

the said method of induced froth (foam) formation process and natural purification utilizes:

a) proper selected food for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms which are the most resistant to the kinds of contaminants or pollutants from which the said water, wastewater, polluted sites of streams or contaminated sites are treated or cleaned-up;

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the said food is either already presented in the said water, wastewater, and polluted sites of streams or contaminated sites in dissolved and/or suspended states, and/or in the form of sediment,

or

the said food in dissolved and/or in suspended states and/or in the form of sediment is added to the said water, wastewater and polluted sites of streams or contaminated sites for promoting the degradation and the decomposition of the said food,

for example, but not limited by this example,

the concentration of the said food in the range from about 0.05 mg/L is added for promoting the degrading and decomposing activities by *Pseudomonas*, *Bacillus*, *Oscillatoria*, *Philodina*, *Carchesium* bacteria and any others which are the most resistant to the cyanide from which, the said water, wastewater, polluted sites of streams or contaminated sites are treated or cleaned-up;

b) organic matter, wherein the said organic matter is either already presented or is not presented in the said water, wastewater, polluted sites of streams or contaminated sites;

c) any external and/or internal conditions for growing the biomass of the groups of bacteria, fungi and other microorganisms which are responsible for the decomposition and the degradation of the said food to produce the biological surfactants such as amino acids, pyruvic acids, fatty acids and/or any others, for example,

but not limited by this example, the temperature of the said entire water, wastewater, polluted sites of streams or contaminated sites is kept at a constant temperature in the range from about 15°C – 50°C

and/or the local heating, in the proper places wherein the said food is located, is provided to keep the local temperature in the range from about 15°C - 50°C;

d) man-made surfactants, wherein the said man-made surfactants is either already presented or is not presented in the said water, wastewater and polluted sites of streams or contaminated sites, for example, but not limited by this example, detergents, oil or any others are presented;

e) any external and/or internal conditions for generating the dissolved biogases and micro-bubbles of biogases in the said water, wastewater, polluted sites of streams or contaminated sites during the decomposition and the degradation of the said food, for example, but not limited by this example, oxygen, ammonia, carbon dioxide, methane, nitrogen and/or any others biogases are generated by decreasing pH up to 4 pH;

f) the dissolved air, wherein the said dissolved air is already presented in the said water, wastewater and polluted sites of streams or contaminated sites or the said air is captured from atmosphere;

g) any external and/or internal conditions for and growing the said micro-bubbles of biogases and/or air bubbles, for example, but not limited by this example, the temperature of entire water, wastewater, polluted or contaminated sites, including benthic soil is kept at a constant temperature in the range from 15°C - 50°C

and/or the local heating in proper places, wherein the said food is located, is provided to keep the local temperature in the range from 15°C - 50°C;

h) any external and/or internal conditions for forming and further rising the aggregates of the said micro-bubbles of biogases and/or the said air bubbles and the said polluting or contaminating particles and/or the decomposed matter from benthic soil which enriched with the said micro-bubbles of biogases in the presence of the said biological and/or the said man-made surfactants to water surface; the said aggregates and/or the said decomposed matter are concentrated in the froth and the surrounding thin top layer of surface water,

for example, but not limited by this example, the proper level of turbulence is provided, wherein additional micro-bubbles of the said biogases and air bubbles are generated and the said aggregates and/or the said decomposed masses from benthic soil rise to the water surface and form the froth and the surrounding thin top layer on surface water downstream from weirs, waterfalls, areas with the shallow-turbulent character of stream current, any obstacles in stream current or any others; or the said weirs, waterfalls, the areas with the shallow-turbulent character of stream current, obstacles in stream current or any others for the said proper level of turbulence are artificially constructed,

or

the tiny air and/or gas bubbles are generated by the artificially created air and/or gases suppliers for pumping air and/or gases to the said water, wastewater, polluted sites of streams or contaminated sites, for example, but not limited by this example, the artificially created pipe or pipes laying on the bottom and generating the tiny air bubbles is provided,

or any other physical and/or chemical reasons;

i) any equipment or equipments, device or devices or any constructions for stopping, concentrating, localizing and collecting the said froth and the said surrounding thin top layer of surface water in the proper places for further skimming off and/or pumping and/or removing from the said proper places and/or redirecting by water flow to natural treatment and/or artificially created natural treatment directly on site, for example, but not limited by this example, the natural biological treatment is used which utilizes algae and/or river bulrushes and/or rushes and/or any other types of plants and/or algae,

or

removal;

k) the said froth and the said surrounding thin top layer of surface water are skimmed off and/or pumped and/or removed from the said proper places for disposal or transporting the said froth and the said surrounding thin top layer of surface water to treatment municipal facilities,

or

the said froth and the said surrounding thin top layer of surface water are skimmed off and/or pumped and/or removed from the said proper places for transporting to the artificial constructed natural treatment facilities, for example, but not limited by this example, the artificially created land with the biological treatment is used.

2. A method of induced froth (foam) formation process and natural purification, as it is claimed in Claim 1, wherein the said equipments or devices are constructed from any materials, for example, but not limited by this example, the said equipments or devices are constructed from the hollow water logs with or without attached metallic plates wrapped or do not wrapped in polyethylene film; the said hollow water logs with or without the said attached metallic plates are tied together and float on surface water and the said equipment stop, concentrate, localize and collect the said froth and the said surrounding thin top layer of surface water in the proper places for further skimming off for disposal or redirecting the said froth and the said surrounding thin top layer of surface water by water flow to the natural treatment directly on site or removing the said froth and the said surrounding thin top layer of surface water to deliver to natural or municipal treatment facilities.

3. A method of induced froth (foam) formation process and natural purification, as it is claimed in Claim 1, is used for treatment of the said water, wastewater wherein the said proper selected food, as it is claimed in Claim 1, for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms which are the most resistant to the kinds of pollutants from which the said water or wastewater are treated is added to tanks, and any other treatment facilities for producing the said biological surfactants and for generating the said dissolved biogases and the said micro-bubbles of biogases; the said tiny air and/or gas bubbles are generated for forming the said aggregates of biogases micro-bubbles, gas and/or air bubbles and the said polluting particles by artificially provided air and/or gases suppliers for pumping the air and/or gases to the said tanks or treatment facilities; the said formed froth and the said surrounding thin top layer of surface water are skimmed off by the said device or devices for disposal or treatment, for example, but not limited by this example, pipe or pipes laying on the bottom and generating the tiny air bubbles under pumping air and/or gases is provided; the resulting froth and the surrounding thin top layer of surface water are skimmed off for disposal or treatment.

4. A method of induced froth (foam) formation process and natural purification, as it is claimed in Claim 1, is used for the said clean-up of polluted sites after toxic, chemical and any other spills into the said streams sites directly on site, wherein the said selected food, as it is claimed in Claim 1, is already presented in the said polluted sites, including in/on benthic soil as a large amount of dead organic matter; the said dead organic matter is served as the said food for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms which are the most resistant to pollutants spilled in the said sites of streams;

a large amount of the said biological surfactants are produced and a large amount of the said dissolved biogases and the said micro-bubbles of biogases are generated; the said man-made surfactants and dissolved air are already presented in the said polluted sites;

the said froth and the said surrounding thin layer of surface water with high concentration of pollutants combined from the entire running water and the benthic soil are formed downstream from already existed or artificially constructed weirs, waterfalls, the areas with shallow-turbulent character of stream current, any obstacles in stream current or any others reasons; one, two or any numbers of the said equipment or

devices, as it is claimed in Claim 1 and Claim 2, for stopping, concentrating, localizing and collecting the said formed froth and the said surrounding thin top layer of surface water are installed, for example, but not limited by this example, as it is shown in Fig. 1; the said froth and the said surrounding thin top layer of surface water are removed and/or skimmed off and/or redirected, during the self-restoration time of the said polluted site, for further disposal or treatment, for example, but not limited by this example, the self-restoration time of the said polluted site is about 3 month,

or

the said froth and the said surrounding thin layer of surface water is formed by pumping the air and/or gases to the benthic soil to mix the polluting particles and degraded matter in/on the said benthic soil with water for lifting them; further the said tiny air and/or gases bubbles are generated to rise the said aggregates and the said degraded matter, as it is claimed in Claim 1, to the surface water; one two or any said devices or equipments, as it is claimed in Claim 1 and Claim 2, are installed downstream from cleaned-up areas for stopping, concentrating, localizing and collecting the said froth and the said surrounding thin layer of surface water; the said froth and the said surrounding thin top layer of surface water are removed and/or skimmed off and/or redirected for further disposal or treatment during the self-restoration time of the said polluted site of streams.

5. A method of induced froth (foam) formation process and natural purification as it is claimed in Claim 1, is used for the said clean-up of the sites polluted from both the point and the non-point polluted sources, wherein the said proper selected food, as it is claimed in Claim 1, either is already presented in the said polluted sites as the following:

- a) the dead natural organic matter in/on the said stream benthic soil and/or the said stream entire water, for example, but not limited by these examples, dead microorganisms, dead alga, dead phytoplankton, dead zooplankton and any others are presented;
- b) the industrial organic pollution, for example but not limited by these examples, the sewage waste and/or the domestic waste and/or any other organic wastes are presented;
- c) the dead natural organic matter in the said stream entire water and/or in/on the said stream benthic soil as a result of the different kinds of runoffs are presented,

or

- e) the said food, as it is claimed in Claim 1, is added to the polluted sites of streams, for examples, but not limited by these examples, the activated sludge or any dead organic matter are added;

the said food is served as a food for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms; the said biological surfactants are produced and the said dissolved biogases and micro-bubbles of biogases are generated; the said man-made surfactants such as detergents, oil and/or chemical contamination and/or any others and dissolved air are already presented in the said polluted sites;

the said froth and the said surrounding thin top layer of surface water are formed downstream from already existed or artificially constructed weirs, waterfalls, the areas with shallow-turbulent character of

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stream current, any obstacles in stream current or any others; one, two or any numbers of the said devices or equipments, as it is claimed in Claim 1 and Claim 2, for stopping, concentrating, localizing and collecting the said formed froth, the said thin top layer of surface water, oil product on water surface as well as any floating debris, including cans and plastic bottles are installed; the said formed froth and the said thin top layer of surface water are skimmed off for disposal and/or redirected to artificially created places for natural treatment directly on site, for example, but not limited by this example, as it is shown in Fig. 2, and/or delivered to municipal or natural treatment facilities.

or

the said froth and the said surrounding thin top layer of surface water is created by pumping the air and/or gases to the benthic soil to mix the polluting particles and degraded matter in/on benthic soil with water and further to generate tiny air and/or gases bubbles; one two or any said devices or equipments are installed downstream from treated or cleaned-up areas for stopping, concentrating and collecting the said froth and the said surrounding thin top layer of surface water by the said equipments or devices, as it is claimed in Claim 1 and Claim 2, for further skimming off for disposal and/or redirecting to artificially created places for natural treatment directly on site and/or deliver to municipal or natural treatment facilities.

6. A method of induced froth (foam) formation process and natural purification, as it is claimed in Claim 1 and Claim 5, utilizes an equipment or equipments for stopping the heavy debris, including tree woods, tree logs and any others after rainfalls; the said equipments are constructed from any materials and the said equipment or equipments are protruded from one bank of the stream to another bank; one, two or any equipments are installed along the said stream, for example, but not limited by this example, the said equipments are constructed from one, two or any numbers of metallic ropes and metallic sticks and the said equipments connect the said one bank of the said stream with the said another bank of the said streams; the said equipments are installed in the said stream, as it is shown in Fig. 3, for stopping debris, including the tree woods, tree logs and any others during rainfall or heavy rainfall for further removal of the said debris from the said streams.

7. A method of induced froth (foam) formation process and natural purification, as it is claimed in Claim 1, and Claim 2, is used for the said clean-up of contaminated sites, wherein the said proper selected food as it is claimed in Claim 1, is added to the said contaminated sites; the said food is served as a food for degrading and decomposing activities by groups of fungi, bacteria and other microorganisms which are the most resistant to the different kinds of contaminants from which the said contaminated sites are cleaned-up; the said biological surfactants are produced and the said dissolved biogases and micro-bubbles of biogases are generated; the said man-made surfactants such as detergents, oil or chemical contamination or any others and dissolved air are either already presented or are not presented in the said contaminated sites;

the said froth and the said surrounding thin top layer of surface water are formed downstream from already existed or artificially constructed weirs, waterfalls, the areas with shallow-turbulent character of stream current, any obstacles in stream current or any others places; one, two or any numbers of the said devices, as it is claimed in Claim 1 and Claim 2, for stopping, concentrating, localizing and collecting the said formed froth and the said surrounding thin top layer of surface water are installed; the said formed

froth and the said surrounding thin top layer of surface water are removed, skimmed off or redirected for further disposal or treatment;

or

the said froth and the said surrounding thin top layer of surface water is created by pumping the air and/or gases to the benthic soil to mix the polluted particles and degraded matter in/on benthic soil with water and further to generate tiny air and/or gases bubbles; one two or any said devices or equipments are installed downstream from treated or cleaned-up areas for stopping, concentrating, localizing and collecting the said froth and the said thin layer of surface water for further removal, skimming or redirect of the said froth and the said surrounding thin top layer of surface stream water by the said equipments or devices, as it is claimed in Claim 1 and Claim 2, for further disposal or treatment.

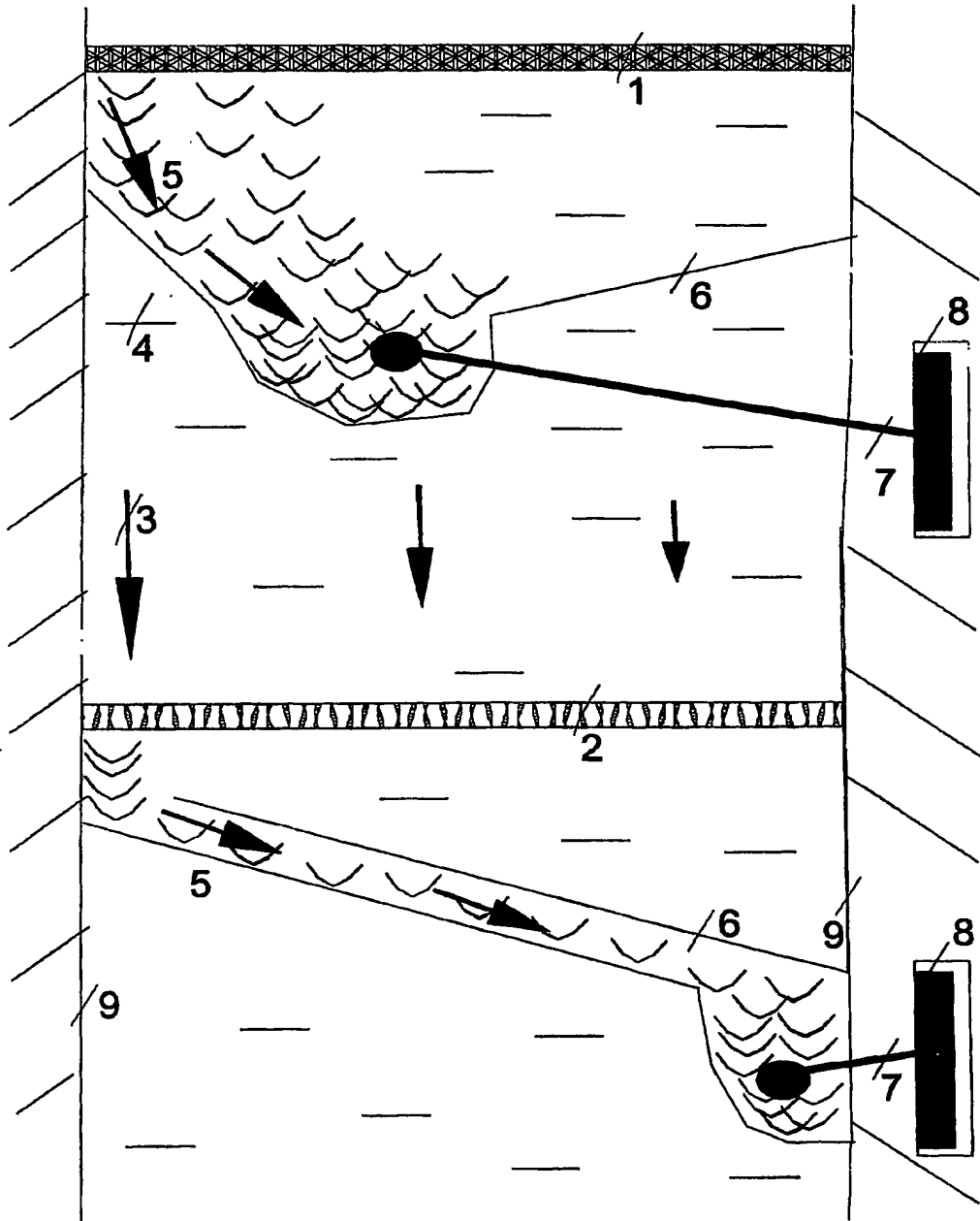


Fig. 1

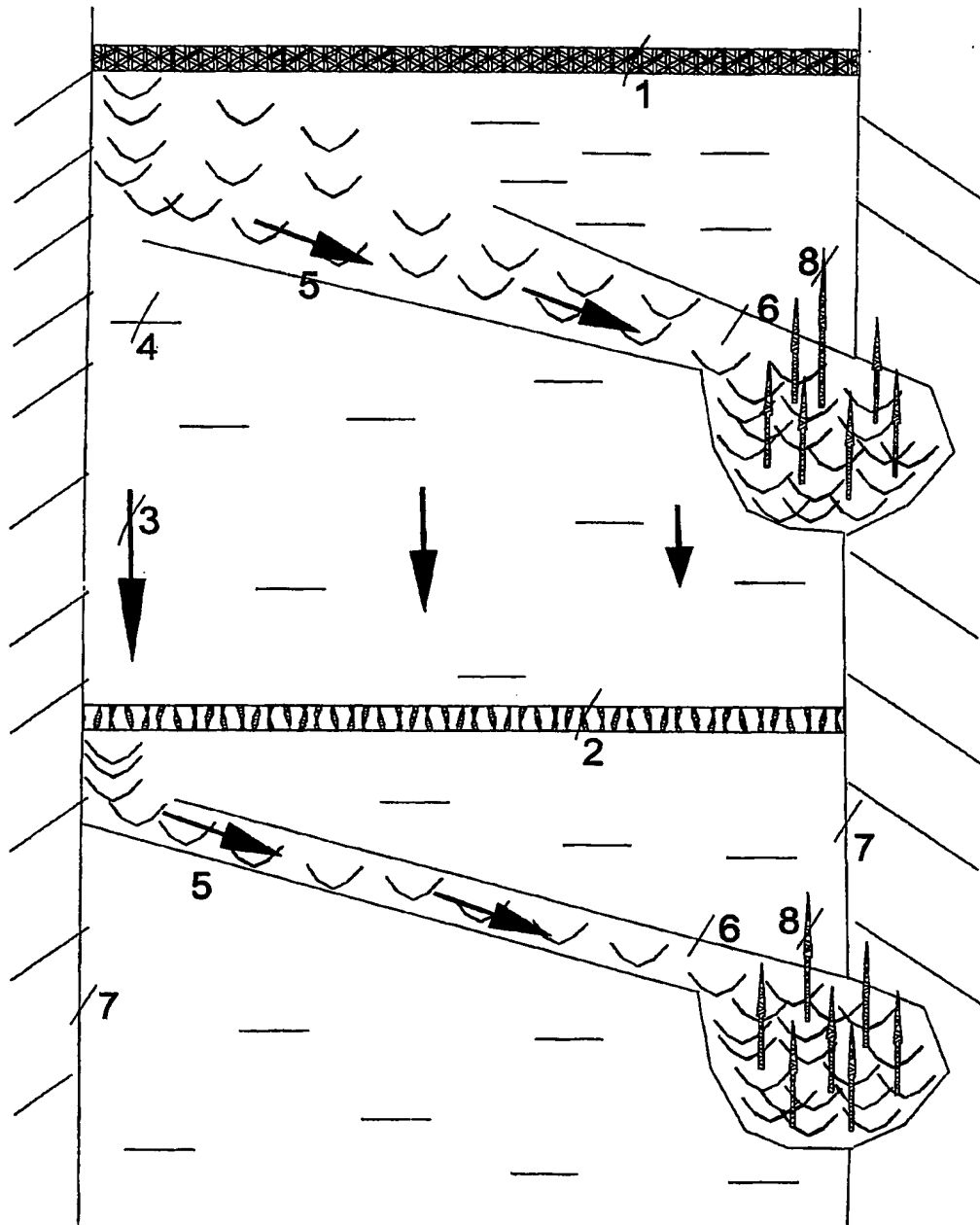


Fig. 2

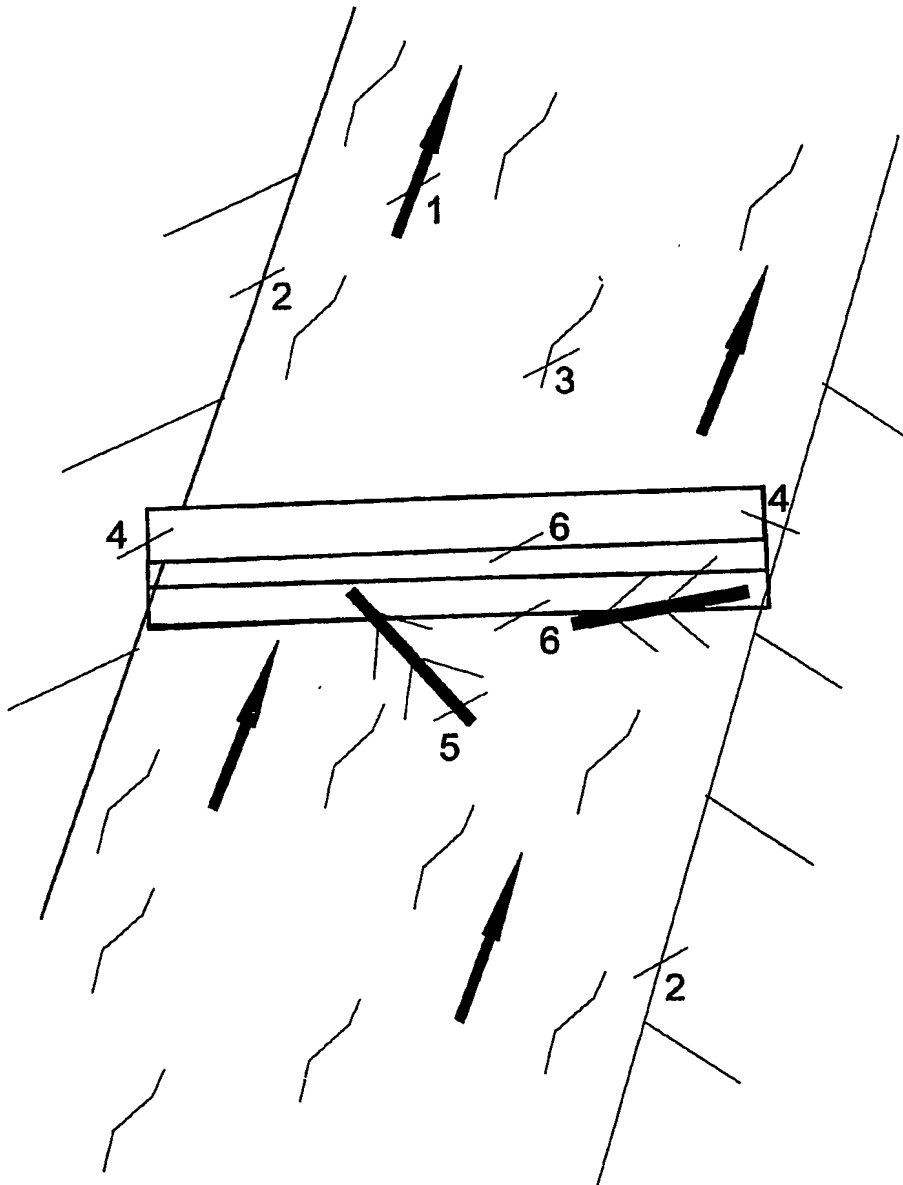


Fig. 3